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Original article

Comparison of blood glucose level in gingival crevicular blood and tissue capillary blood in diabetic and non-diabetic patients

Alaka Subodh [1], Ganesh Shenoy Panchmal [2], Rekha P Shenoy [3], Praveen S Jodalli [4], Laxminarayan Sonde[5], Imran Pasha[6]

[1] Post Graduate Student, Dept. Of Public Health Dentistry,Yenepoya Dental College, Deralakatte, Mangalore
[2] Professor and Head of the Department, Dept. of Public Health Dentistry,Yenepoya Dental College, Deralakatte, Mangalore
[3,4] Reader, Dept. Of Public Health Dentistry,Yenepoya Dental College, Deralakatte, Mangalore
[5,6] Senior lecturer, Dept. Of Public Health Dentistry,Yenepoya Dental College, Deralakatte, Mangalore

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ABSTRACT

Aim: To assess and compare the blood glucose level from gingival crevicular blood and tissue capillary blood in diabetic and non-diabetic patients.

Methods: 35 diabetic and 35 non diabetic patients who had a community periodontal index score 4 and loss of attachment ≥ 1 and are 35 years of age or above were included in the study. Their blood glucose levels were assessed in a glucometer obtained from gingival crevicular blood during periodontal probing and from finger capillary method. Both the blood glucose levels were compared to assess the reliability of blood glucose level obtained from gingival crevicular blood. Data were analysed using paired t test and Pearson correlation.

Results: There was no statistically significant difference between the gingival crevicular blood and finger capillary method blood glucose values in diabetic (p=0.426) and non diabetic patients (p=0.245). Pearson correlation showed a positive correlation between the measurements in diabetic (Correlation Coefficient = 0.930) and non-diabetic patients (Correlation Coefficient = 0.932).

Conclusions: This study showed that gingival crevicular blood collected during routine periodontal examination can be a reliable source of blood for glucometric analysis.

Introduction

Diabetes mellitus is a chronic systemic disease prevalent among the world population. As reported by the World Health Organisation, its prevalence has risen from 108 million in 1980 to 422 million in 2014 around the world. The rise is especially seen among the low and middle income countries. [1] India topped this list of countries in the year 2000 with a population of 31.7 million people with diabetes mellitus and it is predicted to reach 366 million by 2030. [2]

Undiagnosed diabetes mellitus can lead to severe complications like blindness, kidney failure, heart attacks, stroke, nerve damage and periodontal diseases. [1] The risk of occurrence of periodontal disease is approximately three times more in diabetic persons than in non-diabetic ones. [3] Similarly some studies have also showed elevated blood glucose levels in patients with severe periodontitis. [4] Thus there is a two-way relationship between diabetes mellitus and periodontal disease. The issue of undiagnosed diabetes mellitus is especially critical for reduced quality of life and increased levels of morbidity and mortality among these patients. Early diagnosis helps in early treatment and prevention efforts that might prevent or delay the long-term complications of diabetes mellitus. [5]

* Corresponding author: ***Dr. Alaka Subodh Post Graduate student, Dept. of Public Health Dentistry, Yenepoya Dental College,University road,Deralakatte-575018, Mangalore, Karnataka.Email id: alakasubodh@gmail.com , Ph: 9986072075***

This necessitates the present study to collect gingival crevicular blood for glucose measurement using readily available glucometers that measure glucose in a few seconds and is a more practical way that can be done in routine dental visits in chronic periodontitis patients.

Materials and methods

This study was conducted on the patients visiting the Department of Periodontics, Yenepoya Dental College, Deralakatte, Mangalore for a duration of two months (August 2016 – September 2016). The minimum sample size required was 64 with a level of significance = 5%, power =80% and effect size = 0.5 which was computed using the statistical software G* Power 3.1.[6] Accordingly 70 participants who is equal to or greater than 35 years of age were enrolled in the study. The participants met the following inclusion criteria: CPI score equal to 4 and loss of attachment ≥ 1.[7] Criteria for exclusion comprised of patients who require antibiotic prophylaxis prior to invasive dental care, with a history of a bleeding disorder, taking medication interfering with blood coagulation and with a history of systemic disease, such as a cardiovascular, renal, hepatic, or immunologic disorder or under treatment for anaemia, polycythaemia, gout, dialysis, or any other disorder that can cause an abnormally high or low haematocrit.

All participants signed an informed consent form after the study was fully explained to them in their vernacular language. The protocol was reviewed and approved by the Ethics Committee, Yenepoya University, Mangalore and adhered to the Declaration of Helsinki (2013) guidelines.[8] Thirty-five diabetic and thirty-five non diabetic patients were screened for assessing blood glucose level. The examination was done by a single examiner in the outpatient department (OPD) of Department of Periodontics, Yenepoya dental college. The patient was identified as diabetic from the medical history of the patient. If the there is no previous history of diabetes, the patient was considered as non-diabetic.

After obtaining the informed consent, the periodontal status of the subjects was assessed using CPI. Those patients with CPI score equal to 4 and loss of attachment ≥ 1 was included in the study. During the intra oral examination a bleeding gingival site during probing was selected. Once the site is chosen, the area was isolated with cotton rolls to prevent saliva contamination and dried with compressed air to obtain a clean sample quantity of blood (10 to 15 µl) in a capillary tube. The blood from the capillary tube was pushed blown out using a chip blower in the form of a drop into a test trip at the designated spot which is preloaded in a glucometer (Accu-Chek Active, Roche Diabetes Care, Inc., Basel, Switzerland) and the blood glucose level is assessed. The blood sample will be transferred immediately to the glucometer in order to avoid clotting inside capillary tube.

Following the collection of gingical crevicular blood, blood was collected by finger capillary method (FCM). The pad of the finger was wiped with alcohol, and then allowed to dry. The finger was punctured with a lancet device embedded with a sterile lancet needle. The first drop of blood was discarded and the second drop was drawn onto a new test strip preloaded in the glucometer and blood glucose level was assessed. Then both the blood glucose levels were compared.

Statistical analysis:

Statistical tests were done using SPSS software (version19; SPSS, Chicago, IL, USA).Mean, standard deviation and percentage distribution of the data was

Group		Mean	SD	p value
Diabetic (N=35)	GCB	169.00	44.097	0.426
	FCM	171.23	42.682	
Non-Diabetic (N=35)	GCB	129.86	31.533	0.245
	FCM	132.14	29.434	

GCB, gingival crevicular blood; FCM, finger capillary method;
SD, standard deviation.

Table 1: Mean and SD of blood glucose levels obtained from GCB and FCM in diabetic and non-diabetic patients (paired t test)

	Group	Correlation coefficient	p- value
Correlation between GCB & FCM	Diabetic	0.930	<0.001
	Non–diabetic	0.932	<0.001

GCB, gingival crevicular blood; FCM, finger capillary method

Table 2: Correlation between the blood glucose levels obtained from GCB and FCMin diabetic and non-diabetic group (pearson correlation)

obtained and evaluated using descriptive statistics. Paired t test was used to test the significance between the blood glucose levels obtained from GCB and FCM in diabetic and non-diabetic groups. Pearson correlation was used to assess the correlation between the blood glucose levels obtained from GCB and FCM. A p value <0.05 was considered statistically significant. Regression analysis was carried out using ANOVA to predict the FCM blood glucose levels using GCB blood glucose levels.

Results

The study included 70 participants with a mean age of 53.44 years out of which 35 were diabetic and 35 were non diabetic. Among the participants 31 were females and 39 were males. The minimum blood glucose levels obtained in diabetic and non-diabetic participants were 93 and 68 respectively and the maximum levels were 68 and 199 respectively. The blood glucose levels were measured in mg/dl.

As shown in Table 1, comparison between the blood glucose levels assessed from gingival crevicular blood to those blood glucose levels assessed from finger capillary method in diabetic patients showed no much difference. The blood glucose levels assessed from GCB and FCM in non-diabetic patients also showed similar values.

According to Table 2, there was a very high correlation between the blood glucose levels assessed from gingival crevicular blood and finger capillary method in diabetic patients (Correlation Coefficient = 0.930) and also in non-diabetic patients (Correlation Coefficient = 0.932).

Linear regression analysis carried out using ANOVA showed a slight difference in blood glucose values obtained from GCB and FCM in same participant both in diabetic and non-diabetic group (Figure 1). The regression coefficient in this model is 0.913 which shows almost a similar agreement between the GCB and FCM values.

Table 3 also shows a model with a very high correlation between the blood glucose levels assessed from gingival crevicular blood and finger capillary method in diabetic patients (β Coefficient = 0.930) and also in non-diabetic patients (β Coefficient = 0.932).

Discussion

In the present study a comparison was made between the blood glucose levels in gingival crevicular blood and tissue capillary blood in diabetic and non-diabetic patients which showed a very high correlation between them. These findings are in line with the study conducted by Strauss et al and Jain et al which

Group		95% CI	β coefficient	p value
Diabetic (N=35)	FCM	Reference	0.930	<0.001
	GCB	0.773,1.026		
Non-Diabetic (N=35)	FCM	Reference	0.932	<0.001
	GCB	0.750,0.990		

GCB, gingival crevicular blood; FCM, finger capillary method;
CI, confidence interval.

Table 3: Model predicting the correlation between the GCB and FCM blood glucose values (ANOVA)

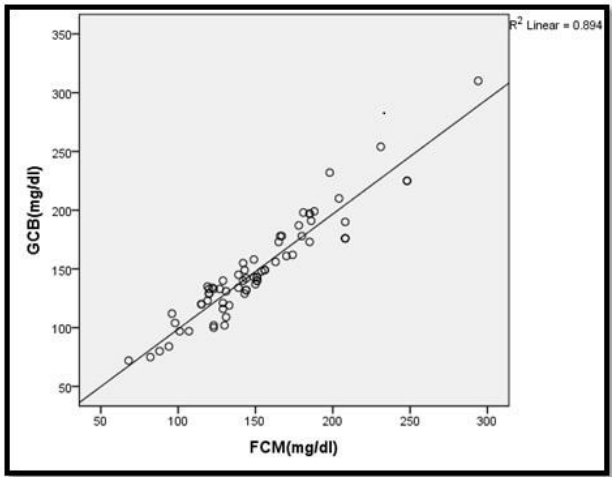

Figure 1. Scatter plot graph with regression line blood glucose levels obtained from GCB and FCM in diabetic and non-diabetic group. GCB, gingival crevicular blood; FCM, finger capillary method; R^2, coefficient of determination and measures how close the data are to the fitted regression line.

also showed a very high correlation of 0.89 and 0.893 respectively between the blood glucose levels obtained from GCB and FCM.[5,9] Beikler et al and Stein et al also conducted studies which showed similar results.[10,11]

Parker et al and Kaur et al assessed the blood glucose level from GCB in a glucose self-monitoring device and compared it with the standard laboratory measurement which also showed a correlation of 0.975 and 0.99 respectively.[12,13] These results suggest that random blood glucose level assessed from GCB can be a reliable source of information. The evaluation of accuracy of the glucometer further adds to the reliability of the source.[14]

Periodontitis is one among the complication of diabetes mellitus. Oral health mirrors general health of an individual. The chronic periodontal disease can be a sign about the undiagnosed diabetes. It is well established that diabetics and periodontal disease have a two way relationship.[3] Periodontitis is more likely to develop in diabetic patients than in non-diabetics [15] and the disease severity is also increases with increased duration of diabetes.[16] In diabetic condition glucose-mediated AGE(Advanced glycation end products) accumulation cause migration and phagocytic activity of mononuclear and polymorphonuclear phagocytic cells that establish more pathogenic sub gingival flora. This gradually matures and transform into gram-negative flora which in turn is a chronic source of systemic challenge. This triggers "infection-mediated" pathway of cytokine upregulation and insulin resistance that affects glucose-utilizing pathways. This amplify the classical pathway of diabetic connective tissue degradation, destruction, and proliferation.[17]

The assessment of blood glucose from GCB using a glucometer can be used in every dental office during routine visit of the patients. This technique is easy to perform and less time consuming than a laboratory test. The periodontium of a diabetic patient tends to bleed more during probing than a non-diabetic patient. A dental practitioner is more familiar with routine probing during periodontal examination and is

method is less traumatic than a finger puncture method.

Conclusion

Based on the findings of the study gingival crevicular blood can provide an acceptable source for measuring blood glucose using glucometer. This method can be used as a reliable chair side method for assessing blood glucose levels during routine dental visit. It can be used as a screening tool in early diagnosis of diabetes mellitus that can result in early treatment and avoidance of serious complications.

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